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Conference Abstract

Combining Ecological and Socio-Environmental Data and Networks to Achieve Sustainability

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Abstract

Environmental degradation in Brazil has been recently amplified by the expansion of agribusiness, livestock and mining activities with dramatic repercussions on ecosystem functions and services. The anthropogenic degradation of landscapes has substantial impacts on indigenous peoples and small organic farmers whose lifestyles are intimately linked to diverse and functional ecosystems.

Understanding how we can apply science and technology to benefit from biodiversity and promote socio-ecological transitions ensuring equitable and sustainable use of common natural resources is a critical challenge brought on by the Anthropocene.

We present our approach to combine biodiversity and environmental data, supported by two funded research projects: DATAPB (Data of Paraíba) to develop tools for FAIR (Findable, Accessible, Interoperable and Reusable) data sharing for governance and educational projects and the International Joint Laboratory IDEAL (artificial Intelligence, Data analytics, and Earth observation applied to sustAinability Lab) launched in 2023 by the French Institute for Sustainable Development (IRD, Institut de Recherche pour le Développement) and co-coordinated by the authors, with 50 researchers in 11 Brazilian and French institutions working on Artificial Intelligence and socio-ecological research in four Brazilian Northeast states: Paraíba, Rio Grande do Norte, Pernambuco, and Ceará (Berti-Equille and Raimundo 2023).

As the keystone of these transdisciplinary projects, the concept-paradigm of socio-ecological coviability (Barrière et al. 2019) proposes that we should explore multiple ways by which relationships between humans and nonhumans (fauna, flora, natural resources) can reach functional and persistent states.

Transdisciplinary approaches to agroecological transitions are urgently needed to address questions such as:

- How can researchers, local communities, and policymakers co-produce participatory diagnoses that depict the coviability of a territory?
- How can we conserve biodiversity and ecosystem functions, promote social inclusion, value traditional knowledge, and strengthen bioeconomies at local and regional scales?
- How can biodiversity, social and environmental data, and networks help local communities in shaping adaptation pathways towards sustainable agroecological practices?

These questions require transdisciplinary approaches and effective collaboration among environmental, social, and computer scientists, with the involvement of local stakeholders (Biggs et al. 2012). As such, our methodology relies on two approaches:

- A large-scale study of socio-ecological determinants of coviability over nine states and 1794 municipalities in Northeast Brazil, combines multiple data sources from IBGE (Instituto Brasileiro de Geografia e Estatística), IPEA (Instituto de Pesquisa Econômica Aplicada) , MapBiomas, Brazil Data Cube, and our partners: GBIF (Global Biodiversity Information Facility), INCT Odisseia (Observatory of the dynamics of the interactions between societes and their environments), and ICMBio (Instituto Chico Mendes de Conservação da Biodiversidade) to enable the computation of proxies and indicators of biodiversity structure, ecosystem functions, and socio-economic organization at different scales. We will perform exploratory data analysis and use artificial intelligence (Rolnick et al. 2022) to identify proxies for adaptability, resilience, and vulnerabilities.
- A multilayer network approach for modeling the interplay between socio-ecological and governance systems will be desgined and tested using adaptive network modeling (Raimundo et al. 2018). Beyond multilayer networks to model socio-ecological dynamics (Keyes et al. 2021), we will incorporate the evolution of the governance systems at the landscape scale and apply Latin Hypercube methods to explore the parameter space (Raimundo et al. 2014) and get a broad characterization of the model dynamics with insights into how the interplay of coupled adaptive systems influence socio-ecological resilience under multiple ecological and socio-economic scenarios. The overall methodology and study case scenarios will be presented.

Keywords

socio-ecological sustainablity, coviability, biodiversity data, multilayer adaptive network, socio-ecological and governance systems

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Ethics and security

Responsible research and innovation (RRI) imply that societal actors (researchers, citizens, policy makers, businesses, third sector organizations, etc.) work together during the whole research and innovation process to better align both the process and its outcomes with the values, needs and expectations of society. The IDEAL IJL has specifically considered RRI issues and already applied to the Brazilian ethics committee, *Comissa~o de E´tica em Pesquisa* (CEP) at UFPB via Plataforma Brazil, which connects CEP-UFPB and the National Committee on Research Ethics (CONEP). Complimentarily, it has been registered in the National System of Management of the Genetic Heritage and Associated Traditional Knowledge (SISGEN, Brazilian Ministry of Environment), which is mandatory for research involving biodiversity and traditional people and communities.

Conflicts of interest

The authors have declared that no competing interests exist.

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